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May 21, 2020

Port of Olympia
Attn: Don Bache
606 Columbia Street NW, Suite 300
Olympia, WA 98501
donb@portolympia.com

Subject: **2020 CATHODIC PROTECTION SYSTEM INSPECTION**
**SHORELINE CONTAINMENT WALL**
**CASCADE POLE SITE**
**OLYMPIA, WASHINGTON**

Dear Mr. Bache:

On May 20, 2020, Norton Corrosion Limited (NCL) personnel completed an inspection of the impressed current cathodic protection (CP) system that protects the buried environmental containment wall at the Cascade Pole site from corrosion. Written authorization to perform this work was issued on March 31, 2020.

Work Performed

NCL thoroughly inspected all accessible components of the CP system to ensure safe and reliable operation. The rectifier was tested to ensure proper operation of all of its components. Current output measurements were recorded for each of the individual anodes. Structure-to-soil potential measurements were recorded at representative test locations along the wall to evaluate the level of CP being received. Both on and instant-off potential measurements were obtained along the inboard and outboard sides of the wall while interrupting the output of the rectifier. Adjustments and maintenance were performed as deemed necessary.

Criteria

NACE International has established criteria that indicate, when used separately or in combination, that adequate CP is being provided. NCL has evaluated your CP system based on the following criteria:

- Adequate CP is indicated by a potential difference of -0.850 volts or more negative between a steel structure and a saturated copper/copper sulfate (CSE) half-cell. This criterion requires all voltage drops, other than those across the structure-to-electrolyte boundary, to be considered for a valid interpretation of the potential data. Instant-off potential measurements were recorded to account for the voltage drops (IR drop) and have been used to evaluate the level of protection achieved. The equivalent criterion applicable to a saturated silver/silver chloride (sat. Ag/AgCl) half-cell is -0.750 volts.

- Adequate protection is also indicated by a cathodic polarization shift of not less than 100 millivolts. This is equivalent to the difference between the instant-off (polarized) and native (depolarized) potential measurements.

Results and Conclusions

The attached data sheets detail the results of the inspection. Survey data indicated the CP system was functioning properly. All equipment was in good and operable condition with the exception of two anodes and the two half-cells that have been previously reported as inoperable. The system had a total current output of 23.0 amps as compared to 22.0 amps reported during last year's inspection.

Both permanent half-cells are out of acceptable limits and are no longer accurate enough for use.

The system was installed in 2001 and should have a 30-year service life. Thus, the anodes have been in service for approximately 60% of its intended design life.

Recommendations

NCL recommends monitoring the rectifier voltage and current output at least once every 60 days. The system should operate near 6 volts and have a minimum current output of 20 amps. The current varies with the tide, increasing as more water covers the anodes located offshore of the wall in the tidal flat.

This system should be inspected by a Corrosion Professional on an annual basis; the next inspection should be scheduled for summer 2021.

NCL appreciates the opportunity to serve the Port of Olympia. If you have any questions or additional concerns, please contact our office.

Sincerely,

Tye Ritz
NACE CP Specialist #9745

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CATHODIC PROTECTION SYSTEM

DATA SHEET: 1 OF 3
NCL JOB: O-23219-M
DATE: 5/20/2020
BY: T. RITZ

# SHORELINE CONTAINMENT WALL

## Structure

| | |
|---|---|
| Description: | Buried sheet pile containment wall. |
| Length: | 400 feet long |
| Depth: | 25 feet |
| Drawings: | NCL, 21015 |

## Rectifier

| | |
|---|---|
| Manufacturer: | Universal Rectifiers |
| Model No: | CSA-ASAI 20-40 |
| Serial No: | 011757 |
| AC Input Rating | 115/230 V, 9.9/4.9 A, 1Ø |
| DC Output Rating: | 20 V, 40 A |
| Anode Bed: | 24 – 1 ½ "ø x 60" cast iron canister anodes |

| Field Measurements | Units | Readings |
|---|---|---|
| Panel Meters and Settings | | |
| Output: | V dc | 6.0 |
| | A dc | 23.0 |
| Primary Input: | | Low V |
| Taps (4/5max): | | 1/5 |
| Portable Meter | | |
| Input: | V ac | 120.0 |
| Secondary: | V ac | 7.62 |
| Output: | V dc | 5.53 |
| | A dc | 22.4 |
| Shunt (50 A/50 mV): | mV | 22.4 |

Conditions: 0930 hrs, mid 50°s F, dry, low tide.
Notes: Fluke 87. Interruption: 2 sec. off, 10 sec. cycle.

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CATHODIC PROTECTION SYSTEM

DATA SHEET: 2 OF 3
NCL JOB: O-23219-M
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**Anode Output Measurements**

| Anode Location | Shunt Reading | Current Output |
|---|---|---|
| 1 - West | 6.9 mV | 0.69 A |
| 2 | 0.0 | 0.00 |
| 3 | 4.3 | 0.43 |
| 4 | 5.0 | 0.50 |
| 5 | 11.4 | 1.14 |
| 6 | 13.1 | 1.31 |
| 7 | 11.5 | 1.15 |
| 8 | 12.1 | 1.21 |
| 9 | 12.2 | 1.22 |
| 10 | 11.1 | 1.11 |
| 11 | 11.6 | 1.16 |
| 12 | 11.7 | 1.17 |
| 13 | 11.6 | 1.16 |
| 14 | 10.1 | 1.01 |
| 15 | 12.2 | 1.22 |
| 16 | 11.4 | 1.14 |
| 17 | 11.7 | 1.17 |
| 18 | 12.7 | 1.27 |
| 19 | 11.8 | 1.18 |
| 20 | 12.0 | 1.20 |
| 21 | 0.0 | 0.00 |
| 22 | 4.8 | 0.48 |
| 23 | 3.5 | 0.35 |
| 24 – East | 4.7 | 0.47 |

Note: Shunts are 0.01 ohm.

PORT OF OLYMPIA
CASCADE POLE SITE
SHORELINE CONTAINMENT WALL
CATHODIC PROTECTION SYSTEM

DATA SHEET: 3 OF 3
NCL JOB: O-23219-M
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**Cathodic Protection Readings**

Structure-to Soil Potential Measurements (V dc)

| Location | Onshore of Wall (ref. CSE) Native* | On | Instant Off | Offshore of Wall (ref CSE) Native* | On | Instant Off |
|---|---|---|---|---|---|---|
| Portable Cell: | | | | | | |
| Fence post 1 | | -1.325 | -1.136 | -0.750 | -1.353 | -1.144 |
| Post 5, adj. E TS | -0.600 | -1.032 | -0.933 | -0.696 | -1.356 | -1.135 |
| Post 10 | -0.665 | -0.965 | -0.935 | -0.806 | -1.571 | -1.156 |
| Post 15 | -0.692 | -0.987 | -0.960 | -0.814 | -1.631 | -1.174 |
| Post 20 | -0.692 | -1.015 | -0.983 | -0.820 | -1.607 | -1.144 |
| Post 25 | -0.644 | -1.003 | -0.968 | -0.833 | -1.593 | -1.173 |
| Post 27, adj. rect | -0.630 | -0.991 | -0.956 | -0.832 | -1.622 | -1.173 |
| Post 30 | -0.656 | -1.002 | -0.976 | -0.840 | -1.569 | -1.173 |
| Post 35 | -0.699 | -1.008 | -0.986 | -0.843 | -1.626 | -1.176 |
| Post 40 | -0.710 | -1.011 | -0.990 | -0.844 | -1.604 | -1.146 |
| Post 45 | -0.691 | -1.004 | -0.982 | -0.810 | -1.349 | -1.150 |
| Post 50 | | -1.217 | -1.122 | -0.756 | -1.307 | -1.139 |
| East T.S. (Post 5): | | | | | | |
| Port. Cell | -0.560 | NA | NA | | | |
| West T.S. (Post 48): | | | | | | |
| Port. Cell | -0.741 | NA | NA | | | |

Note: Native potentials recorded in March, 2012. Both permanent sat. Ag/AgCl cells had previously failed.

# RECTIFIER LOG

OWNER: PORT OF OLYMPIA – Cascade Pole Site

STRUCTURE: Shoreline Environmental Containment Wall

RECOMMENDED CURRENT OUTPUT: 20 to 26 amps (may vary with tide)

| DATE | VOLTS | AMPS | TAPS | INITIAL | COMMENTS |
|---|---|---|---|---|---|
| 5/20/2020 | 6.0 | 23.0 | 1/5 | TR | NCL annual inspection. |
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For assistance, contact NCL at 425-483-1616.